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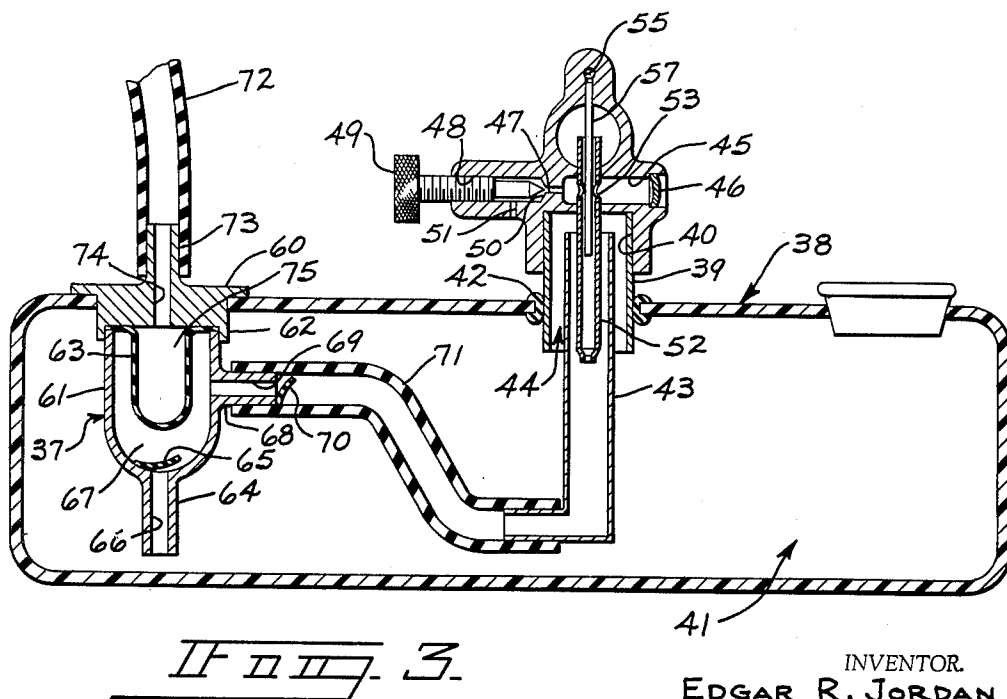
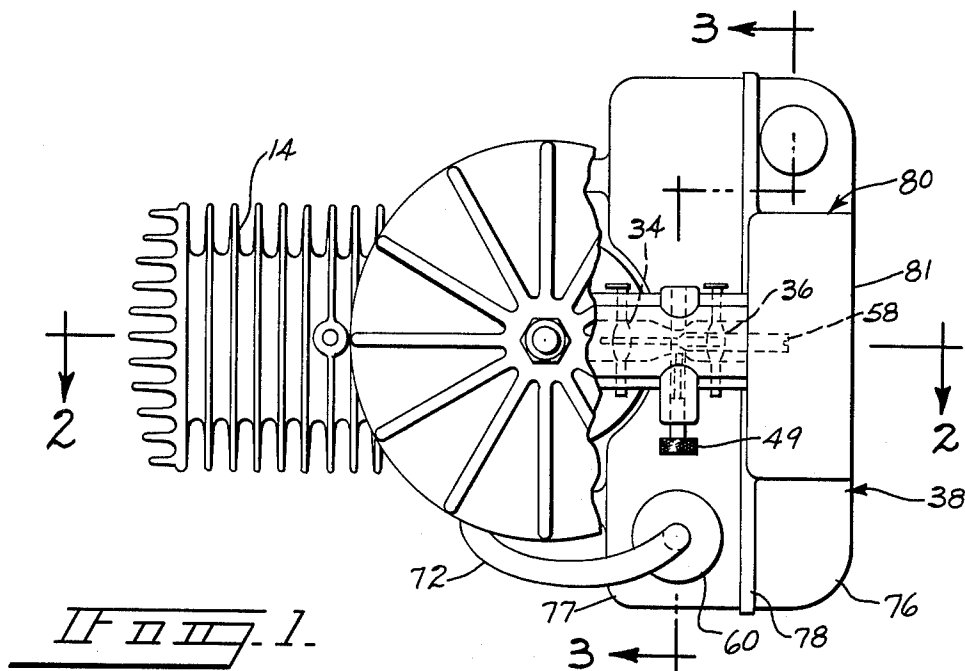
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3,262,433

TWO STROKE CYCLE INTERNAL COMBUSTION ENGINE

Filed Oct. 7, 1963

2 Sheets-Sheet 1



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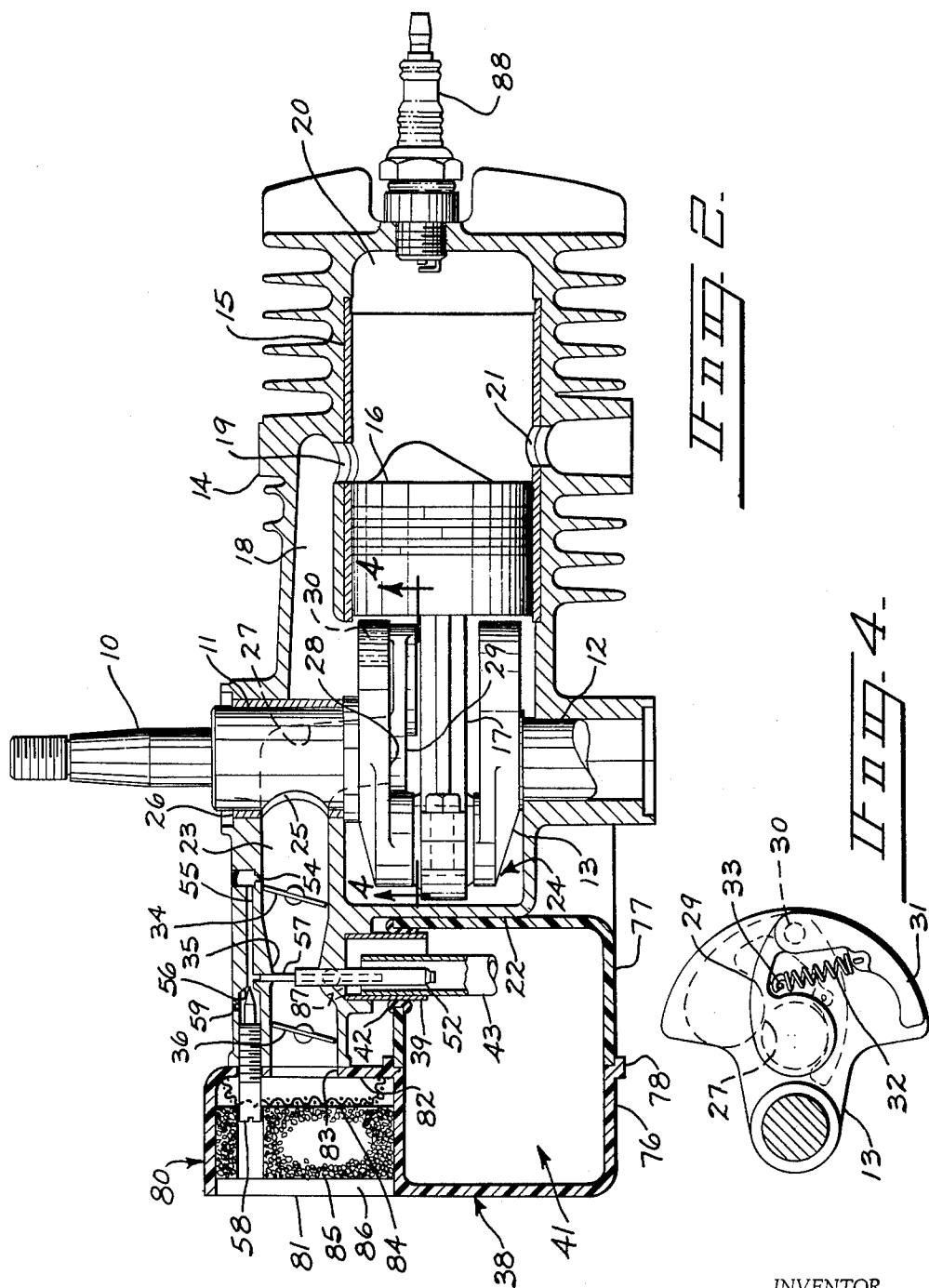
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TWO STROKE CYCLE INTERNAL COMBUSTION ENGINE

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2 Sheets-Sheet 2



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TWO STROKE CYCLE INTERNAL COMBUSTION ENGINE

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The present invention relates to a simplified overall construction of a two stroke cycle internal combustion engine and to the simplified design of its component parts.

An object of the present invention is the provision of a new and improved two-cycle internal combustion engine in which its cylinder housing, its crank case, and the venturi section of its carburetor are made in a total of two cast sections which are preferably formed so as to be capable of being die cast.

Another object of the invention is the provision of a new and improved two-cycle internal combustion engine of the above described type arranged so that the venturi section is at the top of the crankcase and the fuel tank is positioned directly beneath the venturi section.

Another object of the invention is the provision of a new and improved fuel tank that is formed from two molded sections of plastic having internal cavities which are surrounded by matching edge surfaces that are sealed together to form a fuel chamber, and one of the plastic sections having an air filter chamber that is parallel to the fuel chamber and contains an air filtering material for filtering the air flow to an internal combustion engine.

Another object is the provision of a new and improved speed governor arrangement for a two-cycle engine wherein either the crankcase or cylinder housing has a surface of revolution which is in sliding sealing contact with a surface of revolution of the crankshaft, and the crankcase chamber is charged with a fuel-air mixture through an intake passage having cooperating crankcase charging valve ports in said sliding sealing surfaces of revolution, said arrangement including a valve plate carried by the crankshaft and arranged so that centrifugal force causes said valve plate to close off said intake passage at a predetermined speed of rotation of the crankshaft.

Another object of the invention is the provision of a new and improved fuel supply system for an internal combustion engine wherein the fuel tank is located below the carburetor venturi, a pipe is arranged to overflow fuel at a generally predetermined level beneath the venturi, a fuel pump is provided to cause a continuous overflow of fuel at the predetermined level, and means are provided whereby the aspirating effect produced by the venturi raises fuel from the predetermined level to the venturi passage.

Another object of the invention is the provision of a new and improved fuel supply system of the immediately above described type in which the fuel tank is positioned immediately below the venturi section and said fuel supply pipe ends in a vertical pipe which overflows out of its upper end, and the fuel overflow falls directly into the fuel tank.

Another object of the invention is the provision of a new and improved fuel system for an internal combustion engine in which the vent for the fuel tank communicates with the air passage of the carburetor upstream of the throat of the carburetor venturi.

Still another object of the invention is the provision of a new and improved fuel metering system wherein the aspirating effect of a venturi lifts fuel from a predetermined level beneath the venturi to the throat of the venturi through a tube, and the amount of fuel passing through the tube is controlled by regulating a stream of air that is intermingled with the entering fuel.

A still further object of the invention is the provision

of a new and improved idle fuel metering system wherein suction from the air intake of an internal combustion engine downstream of its throttling valve sucks fuel through a fuel passage, and the amount of fuel flowing through the passage is controlled by regulating a stream of air that is intermingled with the entering idle fuel.

The invention resides in certain constructions, combinations, and arrangements of parts, and further objects and advantages of the invention will become apparent to those skilled in the art to which the invention relates from the following description of the preferred embodiment described with reference to the accompanying drawings forming a part of this specification, and in which:

FIGURE 1 is a plan view of an internal combustion engine embodying the present invention, and in which portions of the top flywheel structure are broken away to better show the carburetor venturi section and the fuel tank;

FIGURE 2 is a sectional view taken approximately on the line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view taken approximately on the line 3—3 of FIGURE 1; and

FIGURE 4 is a sectional view taken approximately on the line 4—4 of FIGURE 2.

Although the features of the present invention may be otherwise embodied, they are shown herein as embodied in a two-cycle internal combustion engine. The engine is arranged so that its cylinder section and crankcase section can be die cast, and so that one of the die cast sections includes the venturi passage of the carburetor for the engine.

The engine in the form shown in the drawing comprises a crankshaft 10 that is intended to be mounted in a vertical position, and has journal portions 11 and 12 that are positioned above and below a crank throw portion 13 of the crankshaft 10. The engine has a single cylinder whose housing 14 is die cast of light metal, and may include a cast iron cylinder liner 15. The cylinder housing has a bolting surface which is generally in a plane passing through the center line of the journals 11 and 12. The engine includes a conventional piston 16 mounted for reciprocation within the cylinder liner 15, and the piston 16 is connected to the throw 13 of the crankshaft 10 by a conventional connecting rod structure 17. The cylinder housing 14 is provided with a cast intake passage 18 which extends lengthwise of the cylinder housing from a position below the liner 15 to a position above the outer face of the piston 16 when the piston is near its bottom center position. A transverse opening 19 through the liner 15 and surrounding cast metal forms an intake port which communicates the passage 18 with the combustion chamber 20 above the piston. Another transverse opening 21 through the liner 15 and the cylinder wall but positioned above the transverse opening 19 forms the exhaust port for the engine.

The engine also includes a crankcase section 22 which has a bolting surface to match that of the cylinder housing 14. Although in some instances it would be possible to cast a carburetor venturi section in the cylinder housing 14, a preferred arrangement is achieved by forming the crankcase housing 22 with a venturi passage 23 that extends generally normal to the bolting surface of the crankcase 22, so that it can be conveniently die cast. A further advantage is obtained by locating the venturi passage 23 at a position above the portion of the crankcase housing 22 containing the crankcase chamber 24, as will later be apparent.

Flow of a fuel-air mixture to the crankcase chamber 24 through the venturi passage 23 must be timed to occur when the piston 16 moves inwardly towards the combustion chamber 20, and must be valved off when the piston moves outwardly of the combustion chamber

20 during the power stroke so that the mixture in the crankcase is compressed. The necessary valving operation can be conveniently accomplished by communicating the venturi passage 23 to a surface which has a sliding seal with a matching surface on the crankshaft and by providing a suitable flow passage through the crankshaft so arranged as to align with the venturi passage 23 at the proper position of the crankshaft. In the preferred embodiment, the venturi passage 23 communicates with the journal 11 through an opening 25 in a sleeve bearing 26 that is clamped in a fixed position between the cylinder housing 14 and the crankcase 22. An angular flow passage 27 in the crankshaft communicates the surface of the journal 11 to a radial surface 28 of the crankshaft which faces the piston rod 17. The sleeve bearing 26 not only provides a bearing for the journal 11, but prevents the flow passage 27 from communicating the intake passage 18 directly with the venturi passage 23 during outward movement of the piston 16.

It is another feature of the invention that the maximum speed of the engine be governed by a structure housed within the inside of the engine where it is not subject to performance variations caused by dirt accumulations and cannot be tampered with.

In the embodiment shown in the drawings, a valve plate 29 is pivotally mounted, as at 30, to the crankshaft in such manner that the valve plate can swing over the opening of the passage 27 in the radial surface 28. The valve plate 29 has a counterweight arm 31 fixed thereto which causes the valve plate 29 to swing over the passage 27 as centrifugal force acts upon the counterweight arm 31. A spring 32 is positioned between the counterweight arm 31 and an anchor pin 33 on the crankshaft 10 to normally bias the valve plate 29 to a position opening the passage 27 as shown by the dotted lines in FIG. 4. As the speed of rotation of the crankshaft 10 increases, centrifugal force on the counterweight arm 31 stretches the spring 32, and at a predetermined speed of rotation causes the valve plate 29 to completely close off the passage 27. It will be apparent that other centrifugally operated structures carried by the crankshaft can be used to valve off flow of fuel-air mixtures to the crankcase chambers of two-cycle internal combustion engines. Normal control of the engine is had by a throttle valve 34 positioned between the throat 35 of the venturi and the valve plate 29 of the governor structure within the engine. The engine will preferably also contain a choke valve 36 located upstream of the throat 35. In most of the small, two-cycle engines with which I am familiar only a single, governor controlled throttle valve is used. I have found that better performance is obtained by a separate throttle arrangement by which the governor becomes only a speed limiting device.

The fuel system of the preferred embodiment is also of a simplified construction wherein a pump 37 causes fuel to continuously overflow at a predetermined level beneath the venturi section, from which level the fuel is raised by the aspirating effect of the venturi. In the embodiment shown, the fuel tank 38 is positioned directly beneath the venturi passage 23, and a short section of tubing 39 is pressed into an opening 40 in the casting which forms the body of the venturi passage. The tubing 39 extends down into the fuel chamber 41 of the fuel tank 38, and a suitable seal 42 is provided between the tank 38 and the tubing 39. A fuel supply pipe 43 is positioned vertically within the tubing 39 so that fuel can overflow out of its upper end at a predetermined level, and return to the tank 38 through the annular space 44 between the fuel supply pipe 43 and the tubing 39.

The casting of the crankcase 22 is provided with a horizontal air chamber 45 that is positioned between the top of the opening 40 and the venturi throat 35, and which is separated from each. The outer end of the air chamber 45 is closed off by a plug 46, and air is communicated to the air chamber 45 through a counter-

bored opening 47 that extends from the opposite side of the casting forming the venturi section to the inner end of the air chamber 45. The outer end of the counterbored opening 47 is threaded as at 48 and a needle valve 49 is screwed into the threads 48, so that the inner end of the needle valve 49 can be adjusted relative to the shoulder 50 of the counterbored opening to throttle and control air flow into the air chamber 45. An air inlet passage 51 extends between the counterbored section of the opening 47 and the external surface of the casting to allow air flow into the opening 47.

Fuel is raised from the level established by the top of the overflow tube 43 to the venturi throat 35 by a tube 52 which extends from the throat 35 down through the air chamber 45 into the overflow tube 43. The aspirating effect of air flowing through the throat 35 sucks fuel through the tube 52 into the throat 35, and the upper end of the tube 52 preferably terminates at approximately the center of the throat 35 to achieve more uniform distribution of the fuel in the air stream passing through the throat 35. At least one opening 53 is provided through the walls of the tube 52 between the air chamber 45 and the inside of the tube 52. By adjusting the needle valve 49, the amount of air that is sucked into the tube 52 is controlled to control in turn the amount of fuel fed to the engine.

Fuel for idling the engine when the throttle valve 34 is closed, is provided by a transverse passage 54 which opens into the sidewalls of the venturi passage 23 downstream of the throttle valve 34. A counterbored passage 55 in the casting 22 extends longitudinally over the centerline of the venturi passage 23 to communicate with the transverse passage 54. The shoulder 56 of the counterbored longitudinal passage 55 is positioned outwardly of the throat 35, and an idling tube 57 extends across the throat 35 into the tube 52 to communicate fuel from a point upstream of the opening or openings 53, as the case may be, to the longitudinal passage 55. A needle valve 58 is threaded into the outer end of the counterbored passage 55 for throttling air flowing across the shoulder 56. A lateral passage 59 communicates air from outside of the casting to the passage 55 outwardly of the shoulder 56. By adjusting the needle valve 58, the amount of air sucked into the passage 55 is controlled, and hence the amount of fuel fed to the engine during idling is regulated. The tubes 52 and 57 are preferably located in the center of the overflow tube 43, so that the level of the fluid that is maintained in the tubes 52 and 57 by reason of the overflow effect will not change appreciably regardless of the direction in which the engine may be tipped.

While any type of pump can be used which will provide a more or less continuous flow of fuel to the tubes 52 and 57, the embodiment shown utilizes a diaphragm pump that is operated by means of the pressure pulsations that are produced within the crankcase chamber 24 by the reciprocation of the piston 16. The pump 37 is located within the fuel tank 38 and comprises a flanged cover portion 60, and a bottom bowl shaped portion 61. The lower surface of the cover portion 60 has an axially extending annular flange 62 into which the upper portion of the bowl portion 61 is pressed, and the top peripheral edge of a hat shaped diaphragm 63 is clamped between the top of the bowl 61 and the bottom of the cover 60. The bottom of the bowl 61 has an inlet tube 64 with a flapper valve 65 covering the inlet passage 66 to permit flow into the lower opposing chamber 67 of the bowl but preventing flow out of the lower chamber 67. The bowl 61 also includes an outlet tube 68 whose outlet passage 69 is closed off by a flapper valve 70 which permits flow out of the passage 69 but prevents return flow back into the opposing chamber 67. Fuel is supplied to the fuel supply pipe 43 from the outlet tube 68 by a flexible tube 71. Pressure pulsations from the crankcase chamber 24 are transmitted through tube 72

to a pressure inlet connection 73 having a passageway 74 leading to the top opposing chamber 75 of the fuel pump 37. A pressure pulsation in the top opposing chamber 75 forces diaphragm 63 downwardly to close inlet flapper valve 65 and force fluid out past outlet flapper valve 70. A decrease in pressure in top opposing chamber 75 causes diaphragm 63 to pull upwardly opening inlet flapper valve 65 and closing flapper valve 70 to pull a new charge of fuel into lower opposing chamber 67 for forcing out through the outlet passage 69 upon the next pressure pulsation.

The fuel tank 38 shown in the drawing is also of simplified construction and is made from two molded sections 76 and 77 of a thermo-setting resin, such as phenol formaldehyde. The tank sections 76 and 77 join in a vertical plane and are preferably arranged to fit into each other to provide a rigid joint. In the tank 38 shown, section 76 is provided with a lip 78 into which the end surface of the section 77 is fitted and then heat sealed or sealed with a suitable heat resistant resin, such as an epoxy resin, to provide a fuel chamber 41. The tank 38 also includes an integrally molded portion 80 on one of its sections forming an air filter chamber 81 which is parallel to the portion of the fuel chamber in the section, so that the section can be molded using mold parts which separate in opposite directions. In the tank 38 shown, the outer tank section 76 includes the portion 80, and its air chamber 81 faces in the opposite direction from its fuel chamber. The rear wall 82 is secured to the end of the casting which surrounds the venturi passage 23 and contains an opening 83 which opens into the venturi passage 23. A cup shaped screen 84 is inserted over the opening 83 and a plastic foam filter material 85 is inserted into the open end 86 of the air filter chamber 81 to provide filtered air for the engine. The fuel chamber 41 is vented to the section of the venturi passage 23 between the air filter material 85 and the throat 33 by a drilled opening 87 which is in front of the plane of the section shown in FIG. 3 and so is shown by dot-dash lines.

It is believed that the operation of the engine and its assemblies above described will be apparent to those skilled in the art without a detailed description. By way of a short explanation, the spark plug 88 causes ignition at approximately 26° of crankshaft rotation before the piston 16 reaches the top center of its stroke. The porting of the crankshaft flow passage 27 moves past the venturi passage 23 to prevent further flow of air-fuel mixture to the crankcase chamber 24 approximately 40° after top center of the piston 16. The piston is moved outwardly of the combustion chamber by the pressure produced by the burning gases, and at approximately 110° of crankshaft rotation after top center of the piston, the piston begins to move past the exhaust port 21 to vent the burned gases. At approximately 122½° of crankshaft rotation after top center, the piston 16 begins to uncover the intake port 19, so that gases under pressure in the crankcase chamber 24 flow into the combustion chamber 20 to purge the remaining exhaust gases out through the exhaust port 21 and to fill the combustion chamber with a fresh fuel-air mixture. The crankshaft passage 27 begins to uncover the venturi passage 23 at approximately 30° of crankshaft rotation after bottom center to draw a fresh supply of fuel air mixture into the crankcase chamber 24. The piston 16 closes off the intake port 19 approximately 122½° of crankshaft rotation before the piston reaches top center, and closes off the exhaust port 21 at approximately 110° before top center. Ignition occurs at approximately 26° before top center and the cycle is repeated.

Air flow from the filter material 85 through the venturi passage 23 during movement of the piston into the combustion chamber, produces a flow of air into the crankcase which causes a drop in pressure in the venturi throat

35 which in turn raises fuel from the level established by the top of the fuel supply pipe 43 through the tube 52. Flow through the tube 52 is controlled by the needle valve 49 to provide the proper fuel-air ratio during normal operation. Flow of fuel to the engine during idling is controlled by adjusting the needle valve 58. A continual overflow of fuel from the top of the supply tube 43 establishes a substantially constant fuel level from which the venturi effect of air flowing through the throat 35 raises fuel into the venturi passage 23. Fuel is maintained at the level of the upper end of the supply tube 43 by the pump 37. During each stroke of the piston 16 into the combustion chamber, a small vacuum is created in the crankcase chamber 24 which is transmitted through the tube 72 to the top side of the diaphragm 63. This vacuum on the top of the diaphragm 63 closes outlet valve 70 and opens inlet valve 65 to cause a quantity of fuel to enter the lower opposed chamber 67. During movement of the piston out of the combustion chamber, a pressure pulse is transmitted through the tube 72 to the top side of the diaphragm which moves the diaphragm 63 downwardly. Downward movement of the diaphragm 63 closes inlet valve 65 and forces a quantity of the fuel past outlet valve 70 and causes it to overflow the upper end of the supply tube 43.

It is intended that the speed of the engine will normally be controlled by the regulation of the throttle valve 34. During normal speeds of the engine the valve plate 29 will be held by the spring 32 about in the position shown by the dot-dash lines in FIG. 4, and in which position the flow passage 27 is completely open. At a predetermined high rate of crankshaft rotation, the centrifugal force on the counterweight arm 31 overcomes the force of the spring 32 to cause the valve plate 29 to swing into throttling position over the flow passage 27. The throttling effect will normally prevent further increase in speed of rotation of the engine. A further feature of the invention is accompanied by the fact that the vent passage 87 for the fuel tank communicates with the venturi passage 23 between the filter material 85 and the throat 35. This causes the fuel vapors from the tank to be burned by the engine, and at the same time causes air which enters the fuel tank to be effectively filtered.

While the invention has been described in considerable detail, I do not wish to be limited to the embodiment shown and described, and it is my intention to cover hereby all novel adaptations, modifications, and arrangements thereof which come within the practice of those skilled in the art to which the invention relates.

What I claim is:

1. A two-cycle engine comprising: a crankshaft adapted to be mounted in a generally vertical position, said crankshaft having a crank throw and axially aligned bearing surfaces above and below said crank throw, a cylinder barrel having a cylinder chamber generally opposite said crank throw and having a flat abutment surface on a plane passing through the axis of said cast crankshaft, a crankcase having a flat abutment surface for engagement with said abutment surface of said cylinder barrel, said crankcase including an air intake venturi section including a throat projecting generally opposite the upper bearing surface of said crankshaft generally normal to said abutment surface of said crankcase, a fuel tank positioned below said air intake venturi section, a fuel conduit communicating said throat to a predetermined position beneath said venturi section from which fuel is raised into said throat by vacuum created in said throat, and pump means for raising fuel from said fuel tank to said predetermined position to which said fuel conduit communicates.

2. The two-cycle engine of claim 1 wherein said predetermined position from which fuel is raised is located within said fuel tank, and said pump means comprises a diaphragm pump which is actuated by pressure pulsations from the crankcase of said engine.

3. The two-cycle engine of claim 1 wherein said fuel tank is cast of plastic in two half sections which join in a vertical plane that is generally coextensive with the radially outer end of said venturi section, the section of said fuel tank which is positioned radially outwardly of said venturi section including an integrally-cast air filter chamber having an end wall secured to said venturi section with an air passage communicating said air filter chamber to the air intake of said venturi section.

4. In an internal combustion engine: a crankshaft, a cylinder housing casting having a joining surface on the center line of said crankshaft, a crankcase casting having a joining surface for abutment with said joining surface of said cylinder housing casting, one of said castings and said crankshaft having matching surfaces of revolution which are in sliding sealing engagement and which contain cooperating valve ports, said one of said castings having a cast intake venturi passage that extends away from said surface of revolution of said one of said castings and communicates with its valve port.

5. In an internal combustion engine: a crankshaft having a cylindrical surface by which it is journaled and a crank throw position positioned to one side of said cylindrical surface, a cylinder housing having a joining surface on the center line of said crankshaft, a crankcase having a joining surface for abutment with said joining surface of said cylinder housing, said crankcase having an integrally cast portion having a cast air intake passage extending from said cylindrical surface of said crankshaft and generally perpendicular to said joining surface, said intake passage having a throat section therein, and including an enlarged section between said throat and said cylindrical surface of said crankshaft, and said crankshaft having an air flow passage extending from said cylindrical surface to said crankcase, said air flow passage of said crankshaft sliding past said air intake passage of said crankcase to communicate air flow to said crankcase at predetermined positions of said crankshaft.

6. In an internal combustion engine: a crankshaft having a cylindrical bearing surface, a cylinder housing casting having a joining surface on the center line of said crankshaft, a crankcase casting having a joining surface for abutment with said joining surface of said cylinder housing casting, bearing surfaces on said castings for supporting said bearing surface of said crankshaft, one of said castings having a cast air intake horn with an air passage therethrough communicating with said bearing surfaces, said crankshaft having an air passage communicating said bearing surfaces with said crankcase, both of said air passages having openings in said bearing surfaces arranged to communicate air from said air horn to said crankcase at predetermined positions of said crankshaft.

7. In an internal combustion engine: a crankshaft having a cylindrical bearing surface, a cylinder housing casting having a joining surface on the center line of said crankshaft, a crankcase casting having a joining surface for abutment with said joining surface of said cylinder housing casting, bearing surfaces on said castings for supporting said bearing surface of said crankshaft, said crankcase casting having a cast air intake horn with an air passage therethrough extending away from said cylinder housing and communicating said bearing surfaces with an air intake spaced apart from said cylinder casting, said crankshaft having an air passage communicating said bearing surfaces with said crankcase, both of said air passages having openings in said bearing surfaces arranged to communicate air from said air horn to said crankcase at predetermined positions of said crankshaft.

8. In an internal combustion engine: a crankshaft having an axially extending cylindrical bearing surface and a crank throw portion positioned axially to one end of said bearing portion with a generally radially extending surface extending across the axis of said crankshaft, a cylinder housing casting having a joining surface on the center line of said crankshaft, a crankcase casting having a join-

ing surface for abutment with said joining surface of said cylinder housing casting, bearing surfaces on said castings for supporting said bearing surface of said crankshaft, one of said castings having a cast air intake horn with an air passage therethrough communicating said bearing surfaces with an air inlet, said crankshaft having an air passage communicating said bearing surfaces with said crankcase, both of said air passages having openings in said bearing surfaces arranged to communicate air from said air horn to said crankcase at predetermined positions of said crankshaft, said passage of said crankshaft opening into said generally radially extending surface of said crankshaft, and a valve plate slidably mounted on said radially extending surface for covering said crankshaft passage, said valve plate being rotated by said crankshaft and being arranged so that centrifugal force biases said valve plate over said air passage of said crankshaft at a predetermined speed of said crankshaft.

9. In an internal combustion engine: a crankshaft having an axially extending cylindrical bearing surface and a crank throw portion positioned axially to one end of said bearing portion with a generally radially extending surface extending across the axis of said crankshaft, a cylinder housing casting having a joining surface on the center line of said crankshaft, a crankcase casting having a joining surface for abutment with said joining surface of said cylinder housing casting, bearing surfaces on said castings for supporting said bearing surface of said crankshaft, one of said castings having a cast air intake horn with an air passage therethrough communicating said bearing surfaces with an air inlet, said crankshaft having an air passage communicating said bearing surfaces with said crankcase, both of said air passages having openings in said bearing surfaces arranged to communicate air from said air horn to said crankcase at predetermined positions of said crankshaft, said passage of said crankshaft opening into said generally radially extending surface of said crankshaft, a valve plate slidably mounted on said radially extending surface for covering said crankshaft passage, said valve plate being rotated by said crankshaft and being arranged so that centrifugal force biases said valve plate over said air passage of said crankshaft at a predetermined speed of said crankshaft, and an integral two compartment cell supported over said air horn with said air inlet of said horn communicating with one of said compartments, said one of said compartments having an air intake and filter material interposed between said air intake and said air inlet of said air horn, the other compartment of said integral two compartment cell forming a fuel tank for said engine, and means for pumping fuel from said fuel tank to said engine.

10. A two-cycle engine comprising: a crankshaft adapted to be mounted in a generally vertical position, said crankshaft having a crank throw and an axially extending cylindrical bearing surface positioned above said crank throw, said crank throw portion having a generally radially extending surface extending across the axis of said crankshaft, a cast cylinder barrel having a cylinder chamber generally opposite said crank throw and having a flat abutment surface on a plane passing through the axis of said crankshaft bearing surface, a crankcase casting having a flat abutment surface for engagement with said abutment surface of said cylinder barrel, said crankcase including a cast air intake horn projecting generally opposite the upper bearing surface of said crankshaft generally normal to said abutment surface of said crankcase, bearing surfaces on said castings and which support said bearing surface of said crankshaft, said air intake horn having an air passage therethrough communicating said bearing surfaces with an air intake spaced away from said cylinder casting, said crankshaft having an air passage communicating said bearing surfaces with said generally radially extending surface of said crankshaft, a valve plate slidably mounted on said radially extending surface of said crank throw portion of said

crankshaft for covering said air passage in said crankshaft, said valve plate being rotated by said crankshaft and being arranged so that centrifugal force biases said valve plate over said air passage of said crankshaft at a predetermined speed of said crankshaft, and an integral two compartment cell fixed to said air horn, said cell having upper and lower compartments with said upper compartment communicating with said air passage of said horn, said upper compartment having an air intake and filter material interposed between said air intake and said air passage of said air horn, said lower compartment of said integral two compartment cell forming a fuel tank for said engine, and means for pumping fuel from said fuel tank to said engine.

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